TECHNICAL NOTE

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U.S. DEPARTMENT OF THE INTERIOR – BUREAU OF LAND MANAGEMENT

EROSION CONDITION CLASSIFICATION SYSTEM

by Ronnie Clark

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by

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INTRODUCTION

Soil erosion is the wearing away of the land surface by moving water, wind, ice, and gravity. It is a natural process and probably one of the most important geologic processes to exist. All the sedimentary rocks result from the erosion process. The Grand Canyon was created by erosion. Most of the croplands in the valleys of the Western States are on alluvial deposits resulting from the erosion process.

When man uses the land, he commonly reduces the amount of vegetative cover that existed under natural conditions. Vegetation tends to slow down the rate of erosion because it protects the soil from the attacks of falling raindrops, flowing water, and wind. Reducing the amount of natural vegetation by grazing, tillage practices, logging, or any other method, commonly increases the rate of erosion above that under natural conditions. The increased rate of erosion caused by the influence of man is called "accelerated erosion". Accelerated erosion generally is detrimental. It often reduces the productivity of the land and also increases the sediments in the water courses and the flood plains.

Man cannot completely stop erosion, but his goal should be to keep accelerated erosion to a minimum. The rate of erosion should not be greater than the rate of soil formation. Otherwise, the productivity of the land will diminish and managing the soil on the basis of sustained yields will not be possible. Where accelerated erosion has been excessive, remedial action must be taken to slow down the rate to a safe minimal or tolerance level as shown in Figure 1. Land use and management practices, which keep erosion losses at a safe level, will not only keep the soils permanently productive, but they will also maintain the natural quality of the water resources. This will benefit the aquatic and riparian wildlife as well as the terrestrial wildlife and domestic livestock. Use of the land for grazing, wood fiber production, wildlife habitat, recreation, and water supply will all be enhanced simultaneously under a system which keeps accelerated erosion to a minimal level.

In order for the BLM to determine whether extent of accelerated erosion on the public lands under its jurisdiction is excessive or within tolerated levels, it is necessary to make an inventory of the degree of erosion that has taken place. A prerequisite of the inventory system is a system for defining and classifying different degrees of accelerated erosion. The purposes of this technical note are to: (1) present the erosion condition classification system and (2) to give guidance for the inventory procedure.

Figure 1. Accelerated Erosion. Site, initially, had defined rill ersosion. Flow patterns will evolve into a gully if improved management practices are not implemented.

BACKGROUND

In 1967, the Denver and Portland Service Center personnel were assigned the development of an erosion inventory procedure to be applied to 160 million acres of public lands during the subsequent 5-to-10 year period. Essentially, no quantitative data were in existence nor did the Bureaus have the resources to obtain personnel (in the GS-3 to GS-9 grade levels) to make estimates of current erosion activity. These estimates were based on soil surface features visible to field technicians and reworded as numerical values that were used as a basis for five narrative erosion classes.

The procedure was utilized on 135 million acres of arid and semiarid land from 1971 to 1978, or 2,264 watershed areas. Numerical values describing the erosion condition classes were called Soil Surface Factors (SSF). The factors varied from a value of 1 to 100 and were obtained with an accuracy between inventory party members of ± 5 of the actual value.

In February 1977, a directive was issued to develop a coordinated site inventory procedure to gather baseline soils, vegetation and wildlife data to provide the basic inventory to implement the organic act[1], range management planning, and preparation of environmental statements. This directive provided for developing an operational Site Inventory Method (SIM) for field season 1978 after field-testing in the Worland and Las Cruces districts.

Due to projected costs and manpower requirements, the SIM procedure was revised to provide for the present Soil-Vegetation (Ecological Site) Inventory Method (SVIM). It was recommended by the SIM---Vegetation Allocation Task Force to delete the SSF determination from the procedure since most (84 percent) of the public lands had a Phase 1, Watershed Conservation and Development (WC&D) inventory. A position paper by the author in January 1978 submitted the following rationale for continuance of SSF determination in future inventories:

1. An erosion condition asessment is necessary to correlate with soil properties and ground cover to determine of ecological range condition (seral stage) for each site write-up area.

2. SSF is needed as an index of changes in erosion activity over time with alternative intensities of management and land treatment.

3. Erosion condition data is used as an index to measure apparent trend.

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[1]Public Law 94-579 - Federal Land Management and Public Administration Act, Section 201, Inventory and Identification.

4. SSF parameters are utilized to estimate soil loss or sediment yield as a change measurement in watershed conditions within a time frame.

A decision was made to include the erosion condition assessment in BLM Manual, Section 4412.14D9. The WC&D inventory was an extensive assessment of watershed needs by analysis of areas (1,280 to 10,000 acres per sample unit) and the Bureau needed the erosion condition data at an intensive inventory level to implement the Organic Act.

OBJECTIVE

The objective of this technical note are: (1) to present a revised system for classifying the degree of accelerated erosion condition and (2) to give guidance on the field method for measuring the erosion condition class for a sample area. The revised classification system makes use of the same erosional features used to evaluate the degree of erosion for the past ten years. The degree of rilling and gullying are to be evaluated for every case where water is the dominant erosional agent. They will not be used in the evaluation for areas in which wind is the dominant erosional agent. It is expected that these changes will result in a higher degree of replication of results between individuals evaluating the same area, and a higher degree of uniformity in measured results for comparable conditions between different areas.

Today, most of the erosion condition inventory work is being done as part of the SVIM inventory process. Many of the SVIM inventory crew members are not well trained in the causes and effects of erosion. Therefore, there have been requests for preparing a technical note that is easily understood by range conservationists, foresters, wildlife and fishery biologists, botanists, recreational specialists, as well as by hydrologists and soil scientists. A recommended reference for more detailed information about the causes and effects of erosion is Rangeland Hydrology (Branson et. al., 1972).

Classification System

Field observations are made on seven surface features that are visually affected by current wind and water erosion activity: soil movement, surface litter, surface rock fragments, pedestalling, flow patterns, rills, and gullies. All of these are not expected to be present in the same degree. In certain situations, some, like surface rock fragments, may not be potentially present. When this occurs, adjustments are made as will be shown in Illustrations 1 through 3. While observing these features, the total area to be represented must be kept in mind as significant variation may occur within the area.

The meaning of terms used in this procedure may not be the same for all of us. To aid you in understanding the procedure, these terms are defined in Appendix 1, Glossary of Terms.

Procedure

The five (5) steps follow:

1. The initial step in following this procedure is to determine of the intensity of erosion inventory needed. This may vary from a general erosion inventory, such as the Bureau completed in 1978 on most public lands, or a specific erosion inventory on a small area such as a site writeup area, comparison area, particular land treatment area, or soil type delineation. See BLM Manual, Sections 7317.12 and 4412.14D9, for current guidance for water-

shed inventories (erosion). New guidance replaces previous policy on erosion inventories provided in Phase 1, Watershed Conservation and Development System, Manual Section 7322.1, and Instruction Memorandum No. 79-665. The erosion inventory may be applied to landforms which represent areas of a few acres to several hundred acres.

As part of the inventory plan based on guidance from the preplanning analysis, team members need to decide what is to be sampled. As mentioned in SVIM, BLM Manual, Section 4412.14D1, it is necessary to stratify the inventory area into homogeneous units--called site writeup areas-the basic unit for collecting data on the vegetation and soil resources. Stratification is necessary since it is beyond manpower and funding capability to sample all mapping units.

Caution: The stratified SWA (site writeup area) sampling technique may not be adequate to provide for sampling of all degrees of erosion that are occurring in the inventory area.

Example: Inclusions of more than one soil-vegetation units within a SWA may not be sampled. Data on inclusions is necessary for subsequent data analysis and interpretations.

Therefore, at the mapping stage, all mapping units should have a SSF completed and recorded on Form 4412-26. If time precludes the SSF determination of all mapping units, complete SSF on at least one vegetation-soil unit (including inclusions) in each erosion condition class, if this exists in the inventory area. A key then must be developed for which the data will be interpolated for unsampled vegetation-soil units in each respective erosion condition class.

2. In the second step, the technician should observe the total sample area and determine an average condition for each of the seven items considered in the procedure. These are shown on Table 1, along with weighted value assigned to each item.

   The degree of erosion, as manifested by each of the seven erosion features, is assigned a numerical score ranging between 0 and 14 for all features, except rills and gullies, which have a range of 0 to 15. Two of the features were assigned a maximum score of 15 simply to give a maximum composite score of 100 for all seven features. These numerical scores are called soil surface factor (SSF) values. When used for all the erosional features evaluated together for a sample site, they are called composite SSF values.

Table 1. Determining Erosion Condition Class.

Item	Weighted Value
Soil Movement	14
Surface Litter	14
Surface Rock Fragments	14
Pedestalling	14
Flow Patterns	15
Rills	14
Gullies	15
TOTAL:	100

3. For the third step, it must be determined if each item is potentially present as only these items will be considered. For instance, a soil having no rock coarse fragments within its profile nor other potential source of rock would not be assigned a zero value which would indicate a potential weighted value of 14. Rather, where the potential for rock fragments does not exist, rock fragments are not a valid factor as shown in Illustration 2 and 3.

4. In the fourth step, for those items potentially present, a description should be reviewed and a numerical value should be indicated. Tables 2 through 8 indicate five magnitudes of erosion activity within each of the seven items.

   The total range of SSF values of 0 to 14, or 0 to 15, is divided into five, more or less, equal classes to conform with the five erosion condition classes.

Table 2. Classes for Degree of Recent Soil Movement.

Class	Description	SSF Value
Stable	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between 0 and .1 in. (0 to 2.5 mm).	0 or 3
Slight	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .1 and .2 in. (2.5 to 5 mm).	5
Moderate	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .2 and .4 in. (5 to 10 mm).	8
Critical	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .4 and .8 in. (10 to 20 mm).	11
Severe	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is over .8 in. (20 mm).	14

Table 3. Classes for Degree of Surface Litter Movement.*

Class	Description	SSF Value
Stable	No movement, or if present, less than 2 percent of the litter has been translocated and redeposited against obstacles.	0 or 3
Slight	Between 2 and 10 percent of the litter has been translocated and redeposited against obstacles.	6
Moderate	Between 10 and 25 percent of the litter has been translocated and redeposited against obstacles, or removed from the area.	8
Critical	Between 25 and 50 percent of the litter has been translocated and redeposited against obstacles, or removed from the area.	11
Severe	More than 50 percent of the litter has been translocated and redeposited against obstacles, or removed from the area.	14

*Use judgement on surface litter movement when evaluating low vegetative production sites, as litter may be accumulating in place and very little is evident.

Table 4. Classes for Degree of Surface Rock Fragment Disturbance*

Class	Description	SSF Value
Stable	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is less than .1 in. (2.5 mm).	0 or 2
Slight	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is between .1 and .2 in. (2.5 to 5 mm).	5
Moderate	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is between .2 and .4 in. (5 to 10 mm).	8
Critical	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is between .4 and .8 in. (10 to 20 mm).	11
Severe	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is over .8 in. (20 mm).	14

*Surface rock fragment disturbance is not evaluated where they are more than 40 in. (1 m.) apart or cover less than 0.2 percent of the surface area.

Table 5. Classes for Degree of Pedestalling.*

Class	Description	SSF Value
Stable	Pedestals are mostly less than .1 in. (2.5 mm) high and 1 or less frequent than 2 pedestals per 100 sq. ft.	0 or 3
Slight	Pedestals are mostly between .1 to .3 in. (2.5 to 8 mm) high, and/or have a frequency of 2 to 5 pedestals per 100 sq. ft.	6
Moderate	Pedestals are mostly between .3 to .6 in. (8 to 15 mm) high, and/or have a frequency of 5 to 7 pedestals per 100 sq. ft.	9
Critical	Pedestals are mostly between .6 to 1 in. (15 to 25 mm) high, and/or have a frequency of 7 to 10 pedestals per 100 sq. ft.	11
Severe	Pedestals are mostly over 1 in. (25 mm) high, and/or have a frequency of over 10 pedestals per 100 sq. ft.	14

*Pedestals due to erosion are not to be confused with those caused by frost-heaving. Examination of the roots and crowns of vegetation will assist in this determination.

Table 6. Classes for Degree of Flow Pattern Development.

Class	Description	SSF Value
Stable	None, or if present, less than 2 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.	0 or 3
Slight	Between 2 and 10 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.	6
Moderate	Between 10 and 25 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.	9
Critical	Between 25 and 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.	12
Severe	Over 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter.	15

Table 7. Classes for Frequency and Distribution of Rills

Class	Description	SSF Value
Stable	Rills, if present, are mostly less than .5 in. (13 mm) deep, and generally at infrequent intervals over 10 ft.	0 or 3
Slight	Rills are mostly .5 to 1 in. (13 to 25 mm) deep, and generally at infrequent intervals over 10 ft.	6
Moderate	Rills are mostly 1 to 1.5 in. (25 to 38 mm) deep, and at 10 ft. intervals	9
Critical	Rills are mostly 1.5 to 3 in. (38 to 76 mm) deep, and at intervals of 5 to 10 ft.	12
Severe	Rills are mostly 3 to 6 in. (76 to 152 mm) deep, and at intervals of less than 5 ft.	14

See Illustration 3 for calculation of SSF if there is no potential for rills.

Table 8. Classes for Frequency and Distribution of Gullies

Class	Description	SSF Value
Stable	No gullies, or if present, less than 2 percent of the channel bed and walls show active erosion (are not vegetated) along their length, and/or gullies make up less than 2 percent of the total area.	0 or 3
Slight	Between 2 and 5 percent of the channel bed and walls show active erosion (are not vegetated) along their length, and/or gullies make up between 2 and 5 percent of the total area.	6
Moderate	Between 5 and 10 percent of the channel bed and walls show active erosion (are not vegetated) along their length, and/or gullies make up between 5 and 10 percent of the total area.	9
Critical	Between 10 and 50 percent of the channel bed and walls show active erosion (are not vegetated) along their length, and/or gullies make up between 10 and 50 percent of the total area.	12
Severe	Over 50 percent of the channel bed and walls show active erosion (are not vegetated) along their length, and/or gullies make up over 50 percent of the total area.	15

If gullies are not potentially present, deduct 15 rating points from a possible value of 100 (shown in Illustration 3).

5. The fifth step the technician follows is to total both the weighted values and the potential values for each item. From this, a percentage of the potential is obtained and given the name of soil surface factor (SSF). This becomes the numerical expression of erosion activity and is a unitless number which indicates the percentage of the total potential erosion activity. No attempt is made to differentiate between accelerated or natural erosion activity.

The BLM has developed a classification system to separate the degree of erosion into five erosion condition classes. Table 9 shows the relation of numerical values (SSF's) to one of the erosion condition classes.

Table 9. Erosion Condition Classes and Soil Surface Factors.

Class	Factor Range
Stable	1 - 20
Slight	21 - 40
Moderate	41 - 60
Critical	61 - 80
Severe	81 - 100

These tables provide a narrative description having a similar meaning throughout its area of use, in this case, throughout the eleven Western States. If the procedure is used properly and an individual says he has a moderate erosion condition class on the Missouri River Breaks of Montana, anyone familiar with moderate erosion in California will understand what he is describing. Without this procedure, an individual using a term like slight or critical erosion will likely be the only one who really knows what he is describing.

6. In the sixth step, three examples, Illustrations 1 through 3, have been prepared to help one understand how to determine the SSF representing a given area. Each example has a rating for soil movement, surface litter, pedestalling, and flow patterns. In addition, for Illustration 1, the area has surface rock fragments and potential for rills and gullies. In Illustration 2, the area has gullies, but no potential for surface rock fragments or rills. For Illustration 3, the area has no potential for surface rock fragments, rills, or gullies.

When water is the dominant erosional agent, and rills and/or gullies are absent, the factors are given a value of zero, but are included in the calculation of the composite value for degree of erosional activity (see Figure 2).

Figure 2. Site With No Rills or Gullies. SSF value of 50. Soil movement is recent with deposits around most obstacles between .4 and .8 inches from defined flow patterns on about 30 percent of area; surface litter movement occurs on less than 25 percent of area; surface rock fragments have soil movement and deposition of .2 to .4 inch; pedestals are about 1 inch high with a frequency of 7 to 10 per 100 square feet. No rills or gullies are observed but are potentially present.

Illustration 1. Computation of SSF with All Potential Items.

EROSIONAL FEATURE	EXAMPLE ONE*		
	POTENTIALLY PRESENT	IDENTIFIED FACTORS	POSSIBLE FACTOR
Soil Movement	Yes	11	14
Surface Litter	Yes	8	14
Surface Rock Fragments	Yes	8	14
Pedestalling	Yes	11	14
Flow Patterns	Yes	12	15
Rills	Yes	0	14
Gullies	Yes	0	15
TOTAL		50	100

Total SSF $\frac{50}{100} \times 100 = 50$

*Example one represents an area where all seven erosional features are potentially present. (Example one is shown in Figure 2.)

When all seven erosional features are measured for an area, the sum of the SSF values for all seven features is divided by 100, and that quotient is multiplied by 100 to express the composite SSF values on a percentage basis. One hundred is used in the denominator of the fraction in this equation simply because it is the maximum SSF sum obtainable in the method. Therefore, as shown in Illustration 1, when all seven features are evaluated the composite SSF value is equal to the sum of the individual SSF values. The numerical value for the composite SSF value of 50 obtained for example one, in Illustration 1, puts that area in the moderate erosion condition class which is defined by SSF composite value limits between 41 and 60.

Figure 3. Site With No Potential Surface Rock Fragment or Rilling Potential. SSF value of 33. Soil movement is less than .1 inch, between 2 to 10 percent of the litter is redeposited; pedestals are mostly .1 to .3 inch high and have a frequency of 2 to 5 pedestals per 100 square feet; between 2 and 10 percent of the area have flow patterns; and gullies in the area has less than 2 percent active channel erosion.

Illustration 2. Computation of SSF with No Surface Rock Fragments or Rill Potential.

EROSIONAL FEATURE	EXAMPLE TWO**		
	POTENTIALLY PRESENT	IDENTIFIED FACTORS	POSSIBLE FACTOR
Soil Movement	Yes	3	14
Surface Litter	Yes	6	14
Surface Rock Fragments	No	--	--
Pedestalling	Yes	6	14
Flow Patterns	Yes	6	15
Rills	No	--	--
Gullies	Yes	3	15
TOTAL		24	72

Total SSF $\frac{24}{72} \times 100 = 33$

**Example two represents erosion developed on a vast alluvial fan containing no surface rock fragments or probability for rills. (Figure 3 is the example area.)

Illustration 3. Computation of SSF with No Surface Rock Fragments, Rills, or Gully Potential.

EROSIONAL FEATURE	EXAMPLE THREE***		
	POTENTIALLY PRESENT	IDENTIFIED FACTORS	POSSIBLE FACTOR
Soil Movement	Yes	14	14
Surface Litter	Yes	8	14
Surface Rock Fragments	No	--	--
Pedestalling	Yes	6	14
Flow Patterns	Yes	9	14
Rills	No	--	--
Gullies	No	--	--
TOTAL		37	56

Total SSF $\frac{37}{56} \times 100 = 66$

***Example three represents a soil where wind erosion is the only eroding agent and no surface rock fragments are potentially present. (See Figure 4.)

In examples two and three shown in Illustrations 2 and 3, fewer than the maximum of seven erosional features were represented in the areas and, therefore, could not be measured. When such is the case, the composite SSF value is calculated by dividing the sum of the SSF values of those features actually measured by the sum of the maximum possible SSF values, and multiplying that quotient by 100. By this method the composite SSF value for example two is 33, which places the area in the middle portion of the slight erosion condition class whose limits are between 21 and 40. Had the sum of the SSF values been divided by 100 instead of 72, the composite SSF value would have been 24, and the area would have been classified as more stabilized. Likewise, for example 3, the composite SSF value is 66 based on the exclusion of the three features not measured, whereas it would have only been 37 if the sum of the SSF values for the four items measured would have been divided by 100.

Table 10 is a chart for determining the composite SSF value when fewer than seven of the erosional features are measured for an area. The formula for this calculation is: $Y = X1/X2 \times 100$. Where Y is the composite SSF value, X1 is the sum of the measured individual erosional feature SSF values, and X2 is the sum of the maximum SSF values for those features measured for the area. X2 will always be greater than 56 because it is for the four factors always measured, namely, surface soil movement (14), surface litter movement (14), pedestalling (14), and surface flow pattern (14). Whenever all seven features are measured, X2 will be 100.

Figure 4. Critical Wind Erosion. Site has a SSF value of 66. Note that soil movement deposits exceed .8 inch depth around obstacles; surface litter was translocated on about 25 percent of the area; vegetation and litter pedestalling was infrequent at a height of .1 to .3 inch; flow patterns were present on about 25 percent of the area. There is no potential for surface rock fragment, rilling, or gullying elements.

Table 10. Composite SSF Values (Y) Corresponding to the Sum of the SSF Values for Individual Erosional Features (X1) when the Sum of the Maximum SSF Value (X2) is between 56 and 86.*

	Y when X2 is							
X1	86	85	72	71	70	58	57	56
15	17	18	21	21	21	26	26	27
16	19	19	22	23	23	28	28	29
17	20	20	24	24	24	29	30	30
18	21	21	25	25	26	31	32	32
19	22	22	26	27	27	33	33	34
20	23	24	28	28	29	34	35	36
21	24	25	29	30	30	36	37	38
22	26	26	31	31	31	38	39	39
23	27	27	32	32	33	40	40	41
24	28	28	33	34	34	41	42	43
25	29	29	35	35	36	43	44	45
26	30	31	36	37	37	45	46	46
27	31	32	38	38	39	47	47	48
28	33	33	39	39	40	48	49	50
29	34	34	40	41	41	50	51	52
30	35	35	42	42	43	52	53	54
31	36	36	43	44	44	53	54	55
32	37	38	44	45	46	55	56	57
33	38	39	46	46	47	57	58	59
34	40	40	47	48	49	59	60	61
35	41	41	49	49	50	60	61	63
36	42	42	50	51	51	62	63	64
37	43	44	51	52	53	64	65	66
38	44	45	53	54	54	66	67	68
39	45	46	54	55	56	67	68	70
40	47	47	56	56	57	68	70	71
41	48	48	57	58	59	71	72	73
42	49	49	58	59	60	72	74	75
43	50	51	60	61	61	74	75	77
44	51	52	61	62	63	76	77	79
45	52	53	63	63	64	78	79	80
46	53	54	54	65	66	79	80	82
47	55	55	65	66	67	81	82	84
48	56	56	67	68	69	83	84	86
49	57	58	68	69	70	84	86	88
50	58	59	69	70	71	86	88	89
51	59	60	71	72	73	88	89	91
52	60	61	72	73	74	90	91	93
53	62	62	74	75	76	91	93	95
54	63	64	75	76	77	93	95	96
55	64	65	76	77	79	95	96	98
56	65	66	78	79	80	97	98	
57	66	67	79	80	97	98		
58	67	68	81	82	83			
59	69	69	82	83	84			
60	70	71	83	85	86			
61	71	72	85	86	87			
62	72	73	86	87	89			
63	73	74	88	89	90			
64	74	75	89	90	91			
65	76	76	90	92	93			
66	77	78	92	93	94			
67	78	79	93	94	96			
68	79	80	94	96	97			
69	80	81	96	97	99			
70	81	82	97	99				
71	83	84	99					
72	84	85						
73	85	86						
74	86	87						
75	87	88						
76	88	89						
77	90	91						
78	91	92						
79	92	93						
80	93	94						
81	94	95						
82	95	96						
83	97	98						
84	98	99						
85	99							

*X2 will always range between 56 and 86 unless it is 100. It will be 56 for the four erosional features, which are never excluded, and will be 100 when all seven features are present.

Accuracy

Experience indicates that the accuracy of consistently estimating the SSF for a given area on a general erosion inventory is ±5. Some individuals are not able to reach this consistency and may be ±10 in their estimates without additional training. However, experience usually helps the field technician to estimate within 5.

Uses of Data

Some of the uses of these procedures are:

1. Erosion conditions and trends can be determined.

2. The gully rating provides input to channel characteristics.

3. Stabilization goals can be set for erosion control programs.

4. Present erosion activity by soil type, management system, land treatment practice, and other comparable conditions.

5. Through a system of "comparison areas" it is possible to estimate erosion reduction potentials with alternative land management treatments.

6. Estimates of sediment yield or soil loss could be determined on areas where no hydrologic monitoring stations are available.

7. Treatment effectiveness on changes in SSF's can be made for use in justification statements.

8. Input can be made into livestock grazing suitability criteria.

Problems

Some of the problems experienced with the procedure are:

1. The erosional features caused by the most recent erosion event are most obvious. Judgment must then be made concerning them against an "average" condition.

2. Accuracy is not consistently closer than ±5 SSF value.

3. Variations among individual field technicians following the procedure is commonly ±5 SSF value.

4. Variations in the measured SSF value within a geographic area may be ±5 SSF value among small areas having the same actual erosional activity.

5. Determination of representative sampling areas is not uniform. This is much easier when a soil survey is available.

6. When erosion reduction practices are planned for dissimilar areas, unrealistic erosion reduction goals can be obtained.

Field Sheet

Form 7310-12 (Figure 5, next page) is utilized to provide the field technician with information needed to compute the SSF as a basis for estimating erosion condition class.

Figure 5. Determination of Erosion Condition Class.

Form 7310-12

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

By ______ Date ______

Location ______

Total SSF ______

DETERMINATION OF EROSION CONDITION CLASS
SOIL SURFACE FACTOR (SSF)

Soil Movement	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between 0 and .1 in. (0 to 2.5 mm). 0 or 3	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .1 and .2 in. (2. to 5 mm). 5	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .2 and .4 in. (5 to 10 mm). 8	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas, is between .4 and .8 in. (10 to 20 mm). 11	Depth of recent deposits around obstacles, or in microterraces; and/or depth of truncated areas is over .8 in. (20 mm). 14
Surface Litter	No movement, or if present, less than 2 percent of the litter has been translocated and redeposited against obstacles. 0 or 3	Between 2 and 10 percent of the litter has been translocated and redeposited against obstacles. 6	Between 10 and 25 percent of the litter has been translocated and redeposited against obstacles. 8	Between 25 and 50 percent of the litter has been translocated and redeposited against obstacles or removed from that area. 11	More than 50 percent of the litter has been translocated and redeposited against obstacles or removed from the area. 14
Surface Rock Fragments	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is less than .1 in. (2.5 mm). 0 or 2	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is between .1 and .2 in. (2.5 to 5 mm). 5	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is between .2 and .4 in. (5 to 10 mm). 8	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is beteeen .4 and .8 in. (10 to 20 mm). 11	Depth of soil removal around the fragments, and/or depth of recent deposits around the fragments is over .8 in. (20 mm) 14
Pedestalling	Pedestals are mostly less than .1 in. (2.5 mm) high and/or less frequent than 2 pedestals per 100 sq. ft. 0 or 3	Pedestals are mostly between .1 to .3 in. (2.5 to 8 mm) high and/or have a frequency of 2 to 5 pedestals per 100 sq. ft. 6	Pedestals are mostly between .3 to .6 in. (8 to 15 mm) high, and/or have a frequency of 5 to 7 pedestals per 100 sq. ft. 9	Pedestals are mostly between .6 and 1 in. (15 to 25 mm) high, and/or have a frequency of 7 to 10 pedestals per 100 aq. ft. 11	Pedestals are mostly over 1 in. (25 mm) high, and/or have a frequency of over 10 pedestals per 100 sq. ft. 14
Flow Patterns	None, or if present, less than 2 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 0 or 3	Between 2 and 10 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 6	Between 10 and 25 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 9	Between 25 and 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 12	Over 50 percent of the surface area shows evidence of recent translocation and deposition of soil and litter. 15
Rills	Rills, if present, are mostly less than .5 in. (13 mm) deep, and generally at infrequent intervals over 10 ft. 0 or 3	Rills are mostly .5 to 1 in. (13 to 25 mm) deep, and generally at infrequent intervals over 10 ft. 6	Rills are mostly 1 to 1.5 in. (25 to 38 mm) deep, and generally at 10 ft. intervals. 9	Rills are mostly 1.5 to 3 in. (38 to 76 mm) deep, and at intervals of 5 to 10 ft. 12	Rills are mostly 3 to 6 in. (76 to 152 mm) deep, and at intervals of less than 5 ft. 14
Gullies	No gullies, or if present, less than 2 percent of the channel bed and walls show active erosion (are not vegetated), gullies make up less than 2 percent of the total area. 0 or 3	Between 2 and 5 percent of the channel-bed and walls show active erosion (are not vegetated), or gullies make up between 2 and 5 percent of the total area. 6	Between 5 and 10 percent of the channel bed and walls show active erosion (are not vegetated), or gullies make up between 5 and 10 percent of the total area. 9	Between 10 and 50 percent of the channel bed and walls show active erosion (are not vegetated), or gullies make up between 10 and 50 percent of the total area. 12	Over 50 percent of the channel bed and walls show active erosion (are not vegetated) along their length, or gullies make up over 50 percent of the total area. 15

WAYS TO IDENTIFY THE EROSIONAL FEATURES

Highlight

Seven indicators of soil movement are described and their reliability for indicating soil loss (erosion) is explained. The indicators are: (1) soil movement, (2) pedestalling, (3) surface litter, (4) surface rock fragments, (5) flow patterns, (6) rills, and (7) gullies. The qualitative approximation of soil movement due to erosion has proved to be reasonably reliable.

Soil Movement

The real cause of soil movement on watersheds lies in soil instability. Some of the factors affecting soil instability are: (1) splash erosion, wind, velocity; (2) soil texture, structure, infiltration, and permeability; (3) slope gradient and length; and (4) cover, such as vegetation, litter, mulch, and stones. However, any disturbance of cover, such as by land use and fire, can accentuate the natural soil instability.

Soil movement is most obvious during windstorms, heavy rainstorms, sudden snowmelt or when intensive land uses (livestock grazing by trampling) are occurring on loose soils. Dust clouds and muddy stream runoff as examples of obvious soil movement, but much of the soil movement occurs without such obvious signs.

A certain amount of soil movement is natural on most wildlands. Rodent and ant activity and frost heaving frequently causes soil movement. However, soil movement is abnormal if the soil mantle is disturbed to create soil losses in excess of those which occurred under natural conditions.

Soil Movement Indicators

A single feature of soil loss cannot be used to accurately determine the erosion condition. It must be supported by additional evidence when evaluating the erosion condition of a site writeup area or sampling unit. For example, soil movement alone is a poor indicator of ecological trend. By the time erosion is apparent, profound changes usually have taken place in cover or a drastic change in soil mantle disturbance (as shown in Fig. 6). Inadequate soil cover may be obvious as an indicator of accelerated soil movement. Where ground cover is depleted to less than the minimum density required to protect the soil mantle, soil movement from relatively small areas may increase at an accelerated rate. A fourfold increase in soil loss as bulk density increases from 0.8 to 1.4 may occur if ground cover is significantly decreased.

Other indicators of unstable soil may be gullied drainageways with active bank cutting and sediment deposition in water bodies and at channel confluences.

Figure 6. Soil Movement. SSF value of 61. Note the microterraces formed by soil movement and deposition. Depth of truncated areas are generally 1 to 3 inches. Therefore, the site is given the maximum value of 14 for soil movement and flow patterns.

Soil and litter movement on steeper slopes is obvious when significant accumulations of soil and litter material have moved downslope as a result of siol mantle disturbance from grazing animal trampling. However, on level or gentle slopes, trampling may result in "churning" the soil to dust or mud. This churning changes the soil structure and contributes to subsequent soil displacement during wind or rainstorms.

Soil movement usually becomes more obvious as slope steepness increases and occurs most readily when antecedent soil moisture is very low or very high. However, two items may be necessary to minimize soil erosion: (1) a ground cover of at least 70 percent (as shown in Fig. 7) and, (2) a soil bulk density of 0.70 or less (Packer, 1961).

Evidence of soil displacement takes two forms on sloping rangeland.

(1) With excessive trailing by livestock or wildlife, the surface is imprinted with nearly level terraces. The banks between these terraces are often steep, exposing soil to subsequent downward movement by water and gravity. The terrace may become a watercourse during rain and serves to concentrate runoff into a water flow with erosive force.

(2) Trampling displacement, not concentrated in trails but more generally distributed over the slope, is marked by soil accumulations on the uphill side of perennial plants and by mounds or ridges downslope. Such displacement is less easily observed than terrace trails but probably is more serious. Terrace trails suggest a degree of stability, possibly only temporary, in which the surface has been reformed over time to accommodate an animal concentration. In contrast, general trampling displacement over the slope suggests that there is no stability except where soil may accumulate on the uphill side of a fairly permanent obstruction.

Lichen lines or breaks, are indicators of soil movement. These lines appear if the surface soil has eroded around stones and rocks covered with lichen. Since lichen only grows on the aboveground portion of stones and rocks, there will be an abrupt, horizontal, break between lichens and rock area that originally was below soil surface (Fig.8).

Lichen growth will keep pace with normal geologic erosion and possibly slightly accelerated erosion. Pronounced lichen lines on stones and rocks are reliable evidence of soil movement at a moderate to severe rate. The space between the lichen lines and the present soil surface indicates the amount of soil movement that has occurred.

Lichen lines are more obvious on elevated terrain, i.e., ridges and mesas. They may not appear on lower slope areas where soil losses may be replaced by deposition of soil or litter that has moved from farther upslope.

Caution: Frost heaving of stones and rocks may create lichen lines, giving a false soil loss appearance.

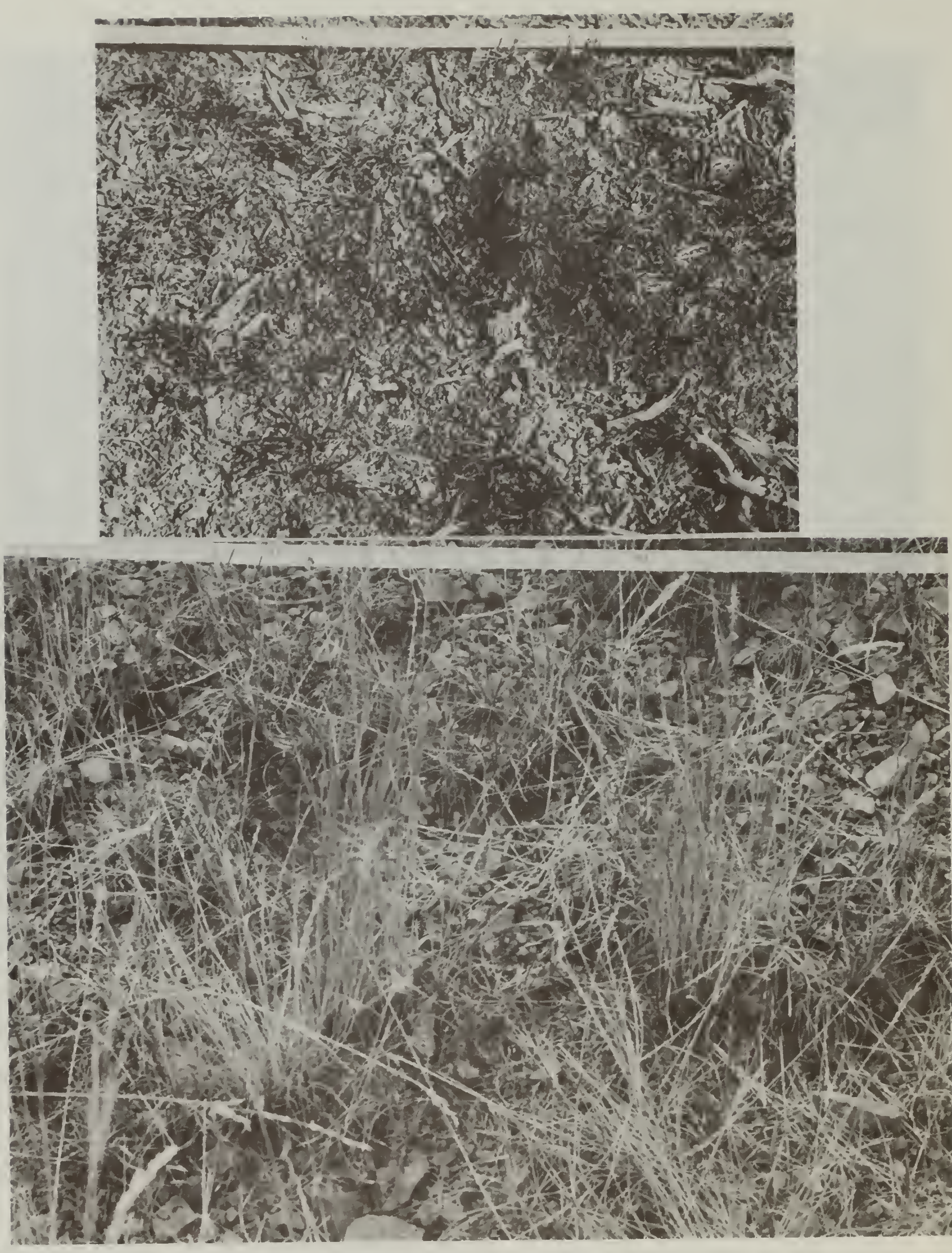

Figure 7. Ground Cover Exceeding 70 Percent. Sites have SSF value of 15. Note the surface litter stability. Pedestalling appearance is not to be confused with growth pattern of bunchgrasses.

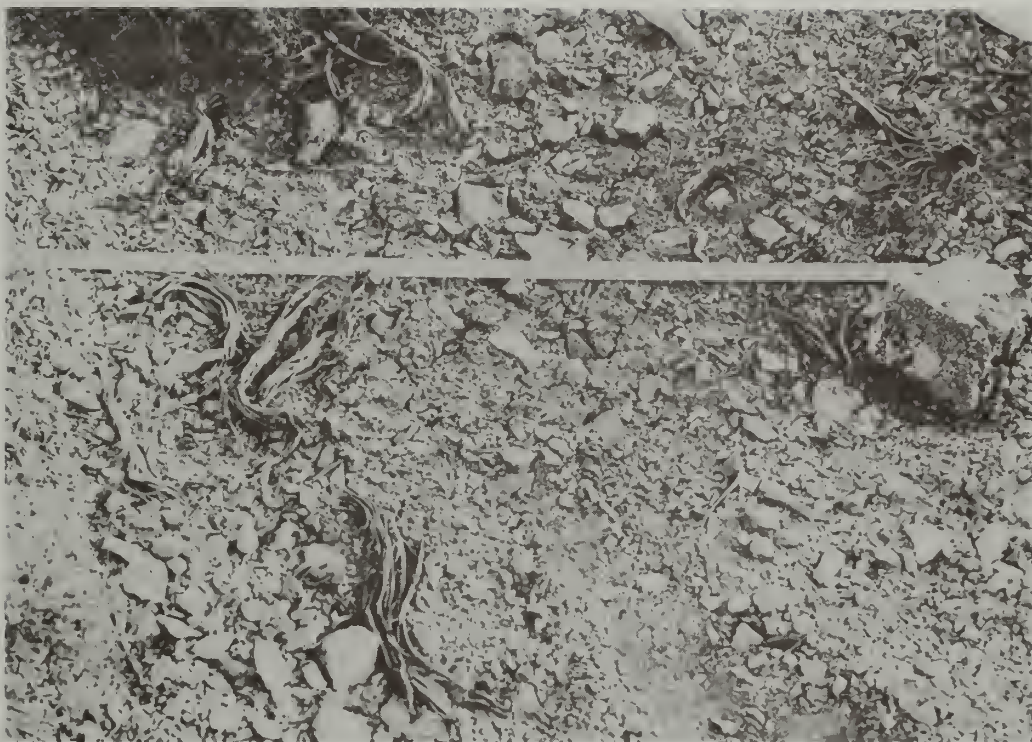

Figure 8. Lichen Line. Note the lichen-covered rock in upper right portion of photograph. Depth of soil movement around surface rock is between .4 and .8 inch and surface rock fragment element was given a value of 11.

Pedestalling

Pedestalling may be observed as small soil pinnacles or plains (Fig. 9). Like miniature mesas remain in position after the soil between mesas has been eroded away.

Pedestals are formed under the protection of stones or pebbles, residue, or vegetation that may consist of a single plant or a small island of a plant community. The latter are more positive indicators of pedestals than single-plant pedestals as indicators because in certain soils single plants often are elevated on a pedestal by frost heaving.

This indicator has value where a former soil surface can be established by the uniform height of pedestals or islands. Similarities of the soil horizons in sections of surface soils of pedestals and islands are excellent for establishing the reliability of this erosional feature. The reliability is good where the soil profile characteristics between the pedestals and islands resemble the soil characteristics at the same depth within the pedestals and islands.

Elevated islands and pedestals may be caused jointly by erosion and deposition, where a part of the eroded area in the locality may supply loose soil to be deposited by wind in clumps of vegetation. The identification of aeolian deposits is discussed under Flow Patterns (in Wind Erosion Prone Areas).

Soil pedestals under stones or litter are formed on some kinds of soil by the impact of raindrops and sheet waterflow over barren, adjacent areas. Where a pebble or stick protects the soil from the impact of raindrops, the original soil under the protecting object is retained, whereas the soil in bare areas is churned by raindrop impacts and easily washes away. Pedestals also are formed on certain soils where the soil ped (a unit of soil structure) is resistant, whereas the soil material in the fracture between peds is less cohesive and susceptible to erosion. Close observation soon after the storm usually is needed to denote these soil pedestals because after a few hours or days of sunshine they may crumble. These pedestals formed during a known period are clues to the sheet erosion rate that has occurred. This indicator is especially valuable as convincing evidence of current soil movement during storms of moderate intensity or duration, which may not form gullies or alluvial deposits.

Frost Heaving

Frost heaving is common in many soils. Care must be exercised to distinguish between soil remnants that are solely the result of erosion from those that are at least partially the result of frost heaving. Distinguishing precisely how much pedestal elevation is due to heaving and how much to erosion is difficult and probably impossible.

Figure 9. Pedestalling. SSF value of 64. Note that the soil and litter is removed by the erosive force of overland flow to create a partial minature mesa. Plant roots are exposed. Site is given a value of 14 since 12 to 15 pedestals are observed per 100 square feet.

Frost heaving often occurs following decimation of the vegetational stand and organic ground cover between plants, which in turn exposes the soil to the effects of periodic low air temperatures. With frost heaving, single plants elevated on pedestals usually characterize the vegetation. These plants commonly are tilted; the crown is not horizontal as it was when it grew as a part of a stable plant community.

The probability that frost heaving has occurred also can be supported by the soil type. The following soils are highly susceptible to frost heaving:

(1) Clay subsoils fairly close to surface.

(2) Pumice (ash) soils.

(3) Soils with greater than 3 percent of material smaller than 0.02 mm.

(4) Soils of high silt (0.05-0.002 mm) and very fine sand (0.10-0.05 mm) if a soil water supply is available.

(5) Soils having a large capillary water capacity if antecedent moisture is available to move to the freezing point. (U.S. Department of Agriculture, 1971).

Surface Rock Fragments (Erosion Pavement)

Surface rock fragments or erosion pavement being referred to here consist of gravel or cobbles concentrated on the soil surface due to the moving of finer soil particles that formerly surrounded them. This surface rock appearance is normal if there is no truncated soil profile and subsurface soil consists of altered rock fragments and parent material. Surface rock relocation due to erosion is substantiated by erosion indicators nearby (Fig. 10).

Caution: Differentiate between eroded soils and soils that naturally have a high gravel or cobble content in the soil surface layers.

It is important to note that evenly distributed surface rock effectively protects the soil surface and slows soil movement. It curtails evaporation, promotes greater moisture holding capacity and reduces runoff velocity if surface rock does not exceed 50 percent of ground cover. It may have an effect similar to vegetation in reducing erosion.

Flow Patterns (in Wind Erosion Prone Areas) - (See Fig. 11)

These are shallow basins varying from a few inches to several feet across in bare soil between vegetated sites from which wind has carried away fine soil particles. This wind action is easily recognized by a residue of small pebbles or sand particles that are too large to be transported by wind and that remain on the scoured surface of the

Figure 10. Surface Rock Movement. SSF value of 84. Flow channels to the left and right of persistent standing litter are filling with surface rock fragments. Site is assigned a value of 14 for this erosion element. Other erosion indicator elements are assigned a value of 11, 12, or 14.

Figure 11. Severe Wind Erosion. Site has a SSF value of 84 (severe erosion condition class) on a sandy range site that is highly susceptible to wind erosion. Depth of recent deposits of soil movement is between .2 and .4 inch; over 50 percent of litter is redeposited against obstacles; pedestals are mostly .6 to 1 inch high and at frequency of 7 to 10 pedestals per 100 square feet; flow patterns are evident over 50 percent of area. Rills, surface rock fragment, and gully elements have no potential.

shallow basin. Fresh scouring by wind on the shallow basins appears as lines etched in the soil surface paralleled by tiny streamlined ridges of fine soil in the leeward side of obstructions (vegetation, litter, pebbles).

Caution: Do not confuse barren areas or ant disks caused by ant colonies with wind-scoured depressions. A collection of sand particles is common and removal of fine soil material by wind from ant disks does occur. Particles of coarse sand and pebbles will occur quite uniformly over a wind-scoured depression; whereas in an ant disks, coarse particles will be aggregated near the center of ant habitation.

The material from wind-scoured depressions or basins is transported to other areas to form aeolian deposits. These deposits, known as dunes, mounds, or hummocks usually occur adjacent to the eroded basin or within the eroding area. Airborne material, because of air current patterns, may occasionally be dumped on distant non-eroding areas such as leeward slopes.

On a smaller scale, deposits may be observed on the leeward side of plants or other obstructions. Such deposits consist of fine, well-sorted soil particles. However, rodent activity may have introduced coarse fragments to the site.

Depositional volume may be determined by cutting a vertical section through a mound and the obstructing material to expose the original soil surface. A comparision should be made to differentiate between the adjacent scoured area and the deposition volume. Relative deposit age may be determined by decomposition rate of buried organic material (vegetation and litter). In older deposits, it may be impossible to identify buried vegetation (organic material).

Flow Patterns (in Areas Subject to Water Erosion) - (See Fig. 12)

Soil materials that have been dislodged, transported and redeposited over the watershed by water are known as alluvial deposits. These deposits are easily discernible as little fans at the end of small channels or behind obstructions in channels (flow paths) where the velocity of runoff has been reduced. They also may be formed as accumulations of soil material or litter on the uphill side of obstructions on the soil surface. As used in this inventory, they are referenced as deposits on the site writeup area (inventory unit), not to fans at major channel mouths.

Hint: Fine soil materials in alluvial deposits indicates slow runoff, whereas coarse soil particles indicates violent or fast runoff.

Figure 12. Flow Patterns. SSF value of 71. Small channels are formed between each obstruction. Soil material or litter translocation and deposition is observed on over 50 percent of surface area. Pedestals are mostly between .6 and 1 inch high with a frequency of 7 to 10 per 100 square feet.

Rills

Rills are small channels, less than 6 inches deep, which are formed by flowing water (Fig. 13). They are so small as to be obliterated by surface soil disturbance or during soil movement associated with weathering. The soil profile may be gradually truncated by rilling. If obliterated, the next storm will cause a new set of rills to form, and these in turn may be obliterated by excessive soil surface disturbance. A high volume of soil can be moved in a short time frame by this process. Often "sheet erosion" is actually rill erosion.

The presence of rills is an excellent indicator of current erosional activity when evaluating changes in erosion produced by land management treatments (Fig. 14). Rills can be measured to produce a quantitative estimate of soil loss by use of the Alutin Method (Hill and Kaiser, 1965).

Gullies

Channels, called gullies, of greater than 6 inches in depth, may be cut into the soil mantle by runoff. Gullies within the sample site generally will be tributaries of intermittent or permanent stream channels that continue outside of the sample site delineation. An active gully is easily detected by unstable sidewalls with little or no vegetation or recent soil loss by erosion. Active cutting, which is called "head-cutting," may be occurring at the channel head.

A healing gully is easily detected by the reestablishment of vegetation on the sidewall and reduction in soil loss in the channel bottom and by the absence of head-cutting activity (as shown in Fig. 15).

A rill enlarges into a gully if repeated cutting and entrenchment occurs. Negligible channel blockage or filling occurs with soil movement during storm runoff.

Figure 13. Rill Erosion. Note the defined small channels of less than 6 inches deep on this silty clay soil.

Figure 14. **Rill Erosion Feature on a Treated Site.** This crested wheatgrass seeding has a SSF of 45 (moderate erosion condition class). Rills were from 3 to 6 inches deep and at intervals of less than 5 feet. Rills value was 14.

Figure 15. Gully Stabilization. Note the mature perennial vegetation established in channel beds and along walls. Site is given a rating for gullies element of 9.

SUMMARY

Thus, the features that indicate erosion are:

1. Percent soil movement
2. Surface litter movement
3. Surface rock fragment distrubance
4. Flow pattern development
5. Pedestalling
6. Rilling
7. Gullying
8. Lichen lines
9. Disturbance of rooting plants
10. Wind-scoured depressions
11. Wind (aeolian) and water (alluvial) deposits
12. Channel sedimentation
13. Channel scouring and ripping

The SSF's explained in this Technical Note and fully evaluated by use of Form 7310-12, Determination of Erosion Condition Class (when totaled) indicate the erosion condition class for use in describing erosion conditions for a specific sample site. After the erosion condition class has been determined for all the major landscape positions in an inventory area, the erosion condition status will be known for each pasture, allotment, resource area, district, state or Western States, collectively. Then, resource managers will be able to apply proper land use and management practices to maintain or enhance soil productivity and a favorable environmental quality.

APPENDIX 1. Glossary of Terms.

antecedent moisture condition (AMC): Amount of soil moisture at the storm beginning.

bare ground: All land surface that is not covered by vegetation, litter, gravel, cobbles, stones or rock outcrop.

bulk density: (Of a soil). The oven-dry weight of measured volume of soil including pore spaces. Expressed in grams per cubic centimeter.

cover: Material covering soil and providing protection from, or resistance to, the impact of raindrops and the energy of overland flow. Expressed in percent of the area covered. Composed of vegetation, litter, gravel, cobbles, stones and rock outcrop, which are lying on or within 20 feet of the ground surface.

erosion: Wearing away of land surface by running water, wind, ice, or other geologic agents. Includes such processes as gravitational creep, detachment and movement of soil or rock by water, wind, ice, or gravity.

accelerated erosion: Primarily as result of influence of man's activities or, in some cases, of animals.

erosion pavement: Layer of coarse fragments of gravel and cobbles on ground surface remaining after removal of fine particles by erosion.

erosion condition class: Condition or grouping of erosion conditions based on degree of erosion or on characteristic erosion patterns applied to total erosion situation. No attempt is made to differentiate among accelerated, normal, natural, or geological erosion. Five classes are recognized (stable, slight, moderate, critical, and severe). Water and wind erosion are both considered.

geologic erosion: Normal or natural erosion caused by geologic processes. (See natural erosion.)

gully erosion: Erosion process whereby water accumulates in narrow channels and, over short periods, removes soil from narrow area to considerable depths, ranging from 6 inches to as much as 75 to 100 feet.

natural erosion: Wearing away of earth's surface by water, ice, or other natural agents under natural environmental conditions of climate or vegetation, undisturbed by man. Synonymous with geologic erosion.

normal erosion: Gradual erosion of land used by man which does not greatly exceed natural erosion and is not greater than the rate of formation of the soil mantle by natural weathering processes.

rill erosion: Erosion process in which small channels of less than 6 inches depth are formed.

sheet erosion: Removal of a fairly uniform layer of soil from land surface by runoff water flowing in a sheet instead of in defined channels.

splash erosion: Spattering of small soil particles caused by impact of raindrops on soils. Loosened and spattered particles may or may not be subsequently transported by surface runoff.

flow patterns: Arrangement of soil particles, surface litter, coarse rock fragments, and pedestals which reflect surface-water flow or wind movement.

gullies: Distinction between gullies and rills is depth. Gullies are over six inches deep. A gully is a channel or miniature valley cut into soil mantle by concentrated runoff through which water only flows during and (immediately after) rains or during snowmelt.

infiltration: Water passage into soil surface.

litter: Organic debris composed of freshly fallen or slightly decomposed organic materials. Includes all undecomposed dead organic matter either lying on the surface or standing within 20 feet of ground surface. Litter includes lichens and moss less than 1/16 inch thick unless they are growing on rock fragments or rock outcrop.

overland flow: Rain water or snowmelt over land surface toward channels.

pedestalling: The process of forming a small elevated plane by the erosion of adjacent areas from around an object. Does not pertain to pedestals created by heaving from frost action.

rills: Small, intermittent watercourse in soil mantle, less than six inches deep with steep sides. It may be obliterated easily by surface disturbance or slight soil movement associated with weathering. Yet in the process the soil profile is gradually truncated.

scour: To abrade and wear away; the wearing away of terraces, diversion channels, or streambeds.

sediment load: Total sediment, including bedload, being moved by flowing water in a stream at a specified cross section.

soil movement: Displacement of the soil mantle by water, wind, ice, gravity, or land use.

soil surface factor (SSF): Numerical expression of surface erosion activity caused by wind and water as reflected by soil movement, surface litter, erosion pavement, pedestalling, rills, flow patterns, and gullies. Values vary from 0 for stable erosion condition to 100 for a severe condition.

surface litter: Nondecomposed dead organic matter lying on ground surface or near enough to it to be affected by water or wind acting on eroding surface.

surface rock fragments: Rock fragments of all sizes lying on or in soil surface; those of primary concern are small enough to reflect movement by water and wind. Includes gravel, cobbles, and stones.

vegetation: Includes all living vegetation within 20 feet of the ground surface, such as the canopy of trees and shrubs, and lichens and moss, more than 1/16 inch thick and only the basal area of grasses and forbs. All live organic floral materials, regardless of form, are to be grouped into vegetation; exceptions to this are the lichens and mosses that are growing on rocks. For the purpose of this survey if the lichens and/or moss has not accumulated a thickness in excess of 1/16 inch, it should be recorded as rock fragments. Lichens and moss on bare ground having a thickness less than 1/16 inch should be recorded as litter rather than vegetation.

APPENDIX 2. Selected References.

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